

DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
MISSOULA WATER RESOURCES REGIONAL OFFICE



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MEMORANDUM

To: Reserved Water Rights Compact Commission (RWRCC)

From: Ethan Mace, Surface Water Hydrologist
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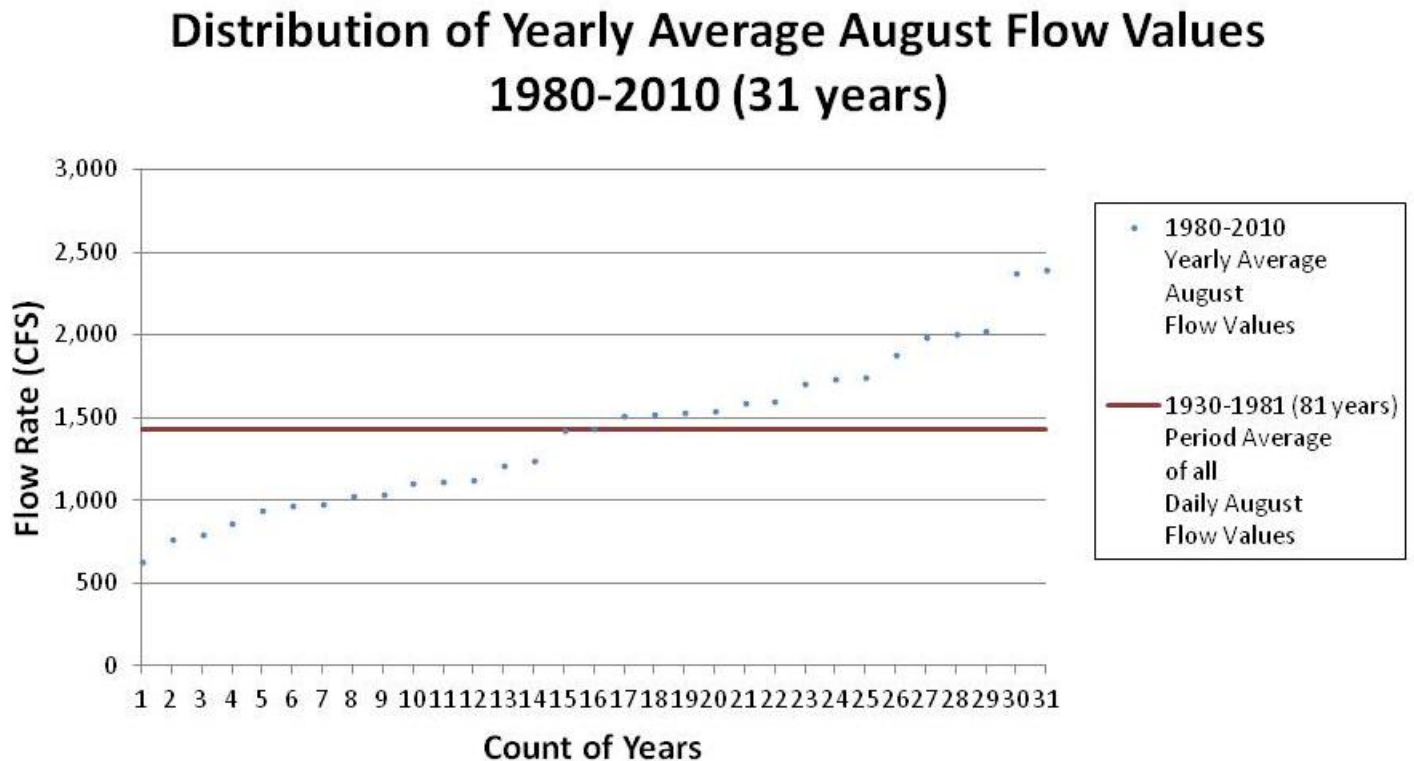
RE: Statistics for assessing the State's proposed Milltown Dam Enforceable Hydrograph

I was asked by the Montana RWRCC to prepare statistical comparisons of historic flow data and the State of Montana's proposed enforceable hydrograph (EH) for the Clark Fork River below former Milltown Dam at USGS Gauge #12340500. It was requested that this comparison estimate the probability that river flows would be less than the daily EH values and potential call on junior users might result. I was also asked to characterize the magnitude of this deficit when it does occur.

The State's proposed Clark Fork River EH consists of static daily flow rates tracking the median of the driest 20% daily flows, bound by the maximum value of 2,000 CFS and a minimum value of 1,100 CFS. The average of the driest 20% of years is roughly equivalent to the 10 percentile flow probabilities.

I examined the period of record ranging from 1980 to 2010. Targeting a data range representative of typical August flows seemed prudent as August is the month in which call on junior water users would be most likely. The average August flow values for the 1980-to-2010-period is 1,411 CFS. The total period of record for this location goes as far back as 1930, the average of all August flows from 1930 to 2010 (81 years) is 1,429 CFS, yielding a difference of 18 CFS. Graphically (Figure 1) the individual average August flows for all 31 years in the 1980-to-2010-period were generally representative of the typical August flows for that location for the entire period of record (not including 2011). Fifteen of the years had an average August flow rate above the 1,429 CFS value, while 16 of the years fell below; the standard deviation of the 31 years is approximately 467 CFS. The 1980 to 2010 period seemed representative of typical August flows on the Clark Fork River.

Figure 1. Comparison of 31 average August flow values (1980-2010) with the single average August flow for the entire 81-year-period-of record on the Clark Fork River at USGS gauge #12340500.



These statistics depict the history of flows on the Clark Fork River as compared to the State of Montana's proposed Enforceable Hydrograph at that location (Figure 2). Specifically quantified are the chronologic percentages in which river flows were below the potentially callable limits associated with the proposed EH water right and the average deficit that occur during those times. Other considerations:

- These statistics use a four-day consecutive average daily flow deficit for both call initiation and call termination, as specified by the State's proposal.
- For this comparison, individual days represent approximately 3.2% (1 out of 31) of the total days; all calculations are rounded.
- The Clark Fork River historic flow records at this USGS gauge reflects the current practices of irrigators in both the Blackfoot and Upper Clark Fork River basins.
- Due to temporally isolated weather events and agricultural practices, the deficit frequencies contain small (~3%) anomalies that might not track common expectations.
- The average of the driest 20% years is equivalent to the 10th percentile flow probabilities.
- 2,000 CFS is the maximum on the Milltown Dam water right and also constitutes the maximum on this EH.
- 1,100 CFS is the minimum biological flow target for fishery resources at that location.

Figure 2: Statistical Comparisons of Historic Flow Data and the Enforceable Hydrograph

Deficit Frequency and Magnitude of Clark Fork River Flows as Compared to the State of Montana's Proposed Enforceable Hydrograph Below Milltown Reservoir@USGS Gauge #12340500: 1980-2010 (30 Years): Frequency of Deficit										
Instream Water Right = AVG of Dry 20% years bound by 1,100 CFS Min and 2000 CFS Max										
	Total Deficit Days	Total Deficit Years	AVG Deficit Days Per Deficit Year	Apr	May	Jun	Jul	Aug	Sep	
Total	694	17	41	3% -178	0%	2% -235	8% -194	29% -212	31% -230	
Daily				CFS	CFS	CFS	CFS	CFS	CFS	
1					0%	0%	13% -263	10% -209	32% -278	
2					0%	0%	10% -251	13% -191	32% -288	
3					0%	0%	13% -224	16% -181	35% -267	
4					0%	0%	10% -239	16% -216	35% -264	
5				0%	0%	0%	10% -250	16% -177	39% -242	
6				6% -152	0%	0%	10% -283	19% -169	39% -243	
7				6% -110	0%	0%	10% -228	19% -189	42% -228	
8				6% -105	0%	0%	6% -262	19% -201	35% -263	
9				6% -155	0%	0%	6% -270	23% -200	35% -250	
10				6% -165	0%	0%	6% -251	26% -199	35% -244	
11				3% -101	0%	0%	6% -214	26% -215	32% -258	
12				6% -124	0%	0%	6% -238	26% -221	32% -252	
13				6% -148	0%	3% -150	10% -182	29% -209	32% -251	
14				6% -164	0%	3% -200	6% -144	32% -209	32% -236	
15				6% -163	0%	0%	6% -162	29% -237	32% -224	
16				3% -163	0%	0%	6% -177	32% -227	32% -206	
17				3% -222	0%	0%	6% -157	35% -207	32% -207	
18				3% -251	0%	0%	6% -116	35% -226	32% -210	
19				3% -355	0%	0%	6% -156	39% -220	29% -246	
20				3% -341	0%	0%	6% -157	39% -223	29% -222	
21				3% -275	0%	0%	6% -144	39% -229	29% -217	
22				3% -170	0%	0%	6% -147	39% -218	26% -221	
23				3% -80	0%	0%	6% -145	39% -211	29% -208	
24				3% -51	0%	0%	6% -148	39% -229	26% -209	
25				3% -167	0%	0%	6% -171	39% -224	23% -219	
26				3% -232	0%	3% -210	6% -159	35% -212	23% -219	
27				3% -226	0%	6% -230	6% -169	39% -208	26% -196	
28				0%	0%	10% -303	6% -195	39% -211	26% -184	
29				0%	0%	10% -263	10% -153	39% -198	26% -181	
30				0%	0%	10% -287	10% -176	35% -226	29% -166	
31					0%		10% -198	32% -267		